使用空間與光譜關係之高光譜影像無失真壓縮法

倪銘鴻、張世旭

E-mail: 321473@mail.dyu.edu.tw

摘 要

由於高光譜影像的無失真壓縮之壓縮比仍有改善的空間，因此本論文提出高壓縮比的無失真壓縮演算法。在文獻上使用查表法(LookUp Table,LUT)預測目前頻帶之像素值，演算法具有簡單快速的優點,但因高光譜影像的像素值範圍很大，例如為212， 因此在查表上需要大量的記憶體。在文獻中LAIS-QLUT(Locally Averaged Interband Scaling-QLUT)演算法中其將查表所需的索引值進行量化，能有效降低查表所需的記憶體，並提升其壓縮效果。 高光譜影像各光譜之間與相同頻帶下鄰近像素具有高的相關性，因此本論文提出使用最小平方法(Least Square Method)與多頻帶的量化查表法(QLUT in multi-bands)，降低高光譜圖像在空間和光譜間冗餘資訊，提高像素的預測值準確度，並結合算術編碼和Golomb-Rice編碼對預測差值進行編碼。 當以AVIRIS的影像Cuprite、Jasper Ridge、Lunar Lake、Moffett Field 與Low Altitude進行壓縮測試，得到之平均壓縮比為3.94，其實驗結果證明本論文之方法能有效對高光譜影像進行壓縮。

關鍵詞 : 高光譜影像、Least Square、查表法、LAIS-QLUT、算術編碼、Golomb-Rice編碼

目錄

參考文獻

[1]S.-E. Qian, A. B. Hollinger, D. Williams et al.,“ Vector quantization using spectral index-based multiple subcodebooks for hyperspectral data compression, ” IEEE Transactions on Geoscience and Remote Sensing Letters, vol. 38, no. 3, pp. 1183-1190, 2000.

[2]S.-E. Qian,“ Hyperspectral data compression using a fast vector quantization algorithm, ” IEEE Transactions on Geoscience and Remote Sensing, vol. 42, no. 8, pp. 1791-1798, 2004.

[3]G. Motta, F. Rizzo, and J. Storer,“ Locally Optimal Partitioned Vector Quantization of Hyperspectral Data, ” Hyperspectral Data Compression, pp. 107-146, 2006.

[4]J. Zhang, and G. Liu,“ A novel lossless compression for hyperspectral images by context-based adaptive classified arithmetic coding in wavelet domain, ” IEEE Geoscience and Remote Sensing Letters, vol. 4, no. 3, pp. 461-465, 2007.

[5]C. Emmanuel, M. Corinne, and D. Pierre,“ Hyperspectral image compression: adapting SPIHT and EZW to anisotropic 3-D wavelet coding, ” IEEE Transactions on Image Processing, vol. 17, no. 12, pp. 2334-2346, 2008.

[6]J. Zhang, J. E. Fowler, and G. Liu,“ Lossy-to-lossless compression of hyperspectral imagery using three-dimensional TCE and an integer KLT, ” IEEE Geoscience and Remote Sensing Letters, vol. 5, no. 4, pp. 814-818, 2008.

[7]X. Wu, and N. Memon,“ Context-based lossless interband compression-extending CALIC, ” IEEE Transactions on Image Processing, vol. 9, no. 6, pp. 994-1001, 2000.

[8]F. Rizzo, B. Carpentieri, G. Motta et al.,“ Low-complexity lossless compression of hyperspectral imagery via linear prediction, ” IEEE Signal Processing Letters, vol. 12, no. 2, pp. 138-141, 2005.

[9]S. K. Jain, and D. A. Adjeroh, "Edge-Based Prediction for Lossless Compression of Hyperspectral Images." pp. 153-162.

[10]H. Wang, B. S. Derin, and S. Khalid,“ Lossless hyperspectral-image compression using context-based conditional average, ” IEEE Transactions Geoscience and Remote Sensing Letters, vol. 45, no. 12, pp. 4187-4193, 2007.

[11]L. Bai, M. He, and Y. Dai,“ Lossless compression of hyperspectral images based on 3D context prediction, ” in 2008. ICIEA 2008. 3rd IEEE Conference on Industrial Electronics and Applications, 2008, pp. 1845-1848.

[12]E. Magli,“ Multiband lossless compression of hyperspectral images, ” IEEE Transactions on Geoscience and Remote Sensing, vol. 47, no. 4, pp. 1168-1178, 2009.

[13]K. Aaron B, and K. Matthew A,“ Exploiting calibration-induced artifacts in lossless compression of hyperspectral Imagery, ” IEEE Transactions on Geoscience and Remote Sensing, vol. 47, no. 8, pp. 2672-2678, 2009.

[14]J. Mielikainen, “ Lossless compression of hyperspectral images using lookup tables, ” IEEE Signal Processing Letters, vol. 13, no. 3, pp. 157-160, 2006.
[15]J. Mielikainen, and P. Toivanen, “ Lossless compression of hyperspectral images using a quantized index to lookup tables, ” IEEE Geoscience and Remote Sensing Letters, vol. 5, no. 3, pp. 474-478, 2008.
[16]B. Aiazzi, S. Baronti, and L. Alparone, “ Lossless compression of hyperspectral images using multiband lookup tables, ” IEEE Signal Processing Letters, vol. 16, no. 6, pp. 481-484, 2009.
[17]B. Huang, and Y. Sriraja, “ Lossless compression of hyperspectral imagery via lookup tables with predictor selection, ” Image and Signal Processing for Remote Sensing XII, L. Bruzzone, Ed.,, vol. 6365, pp. 63651-1, 2006.
[18]P. Toivanen, O. Kubasova, and J. Mielikainen, “ Correlation-based band-ordering heuristic for lossless compression of hyperspectral sounder data, ” IEEE Geoscience and Remote Sensing Letters, vol. 2, no. 1, pp. 50-54, 2005.
[19]J. Zhang, and G. Liu, “ An efficient reordering prediction-based lossless compression algorithm for hyperspectral images, ” IEEE Geoscience and Remote Sensing Letters, vol. 4, no. 2, pp. 283-287, 2007.
[20]C. Huo, R. Zhang, and T. Peng, “ Lossless compression of hyperspectral images based on searching optimal multibands for prediction, ” IEEE Geoscience and Remote Sensing Letters, vol. 6, no. 2, pp. 339-343, 2009.
[21]X. Wu, and N. Memon, “ Context-based, adaptive, lossless image coding, ” IEEE Transactions on Communications, vol. 45, no. 4, pp. 437-444, 1997.
[22]B. Aiazzi, L. Alparone, S. Baronti et al., “ Crisp and Fuzzy Adaptive Spectral Predictions for Lossless and Near-Lossless Compression of Hyperspectral Imagery, ” Geoscience and Remote Sensing Letters, IEEE, vol. 4, no. 4, pp. 532-536, 2007.
[23]"AVIRIS Home Page," http://aviris.jpl.nasa.gov/.